

CLAIMS

What is claimed is:

1. A fuzzy distance transform-based computational method for analyzing digital images defining a volumetric region of an object from an image comprising: (a) obtaining an image of the targeted object; (b) finding a plurality of points in the image to generate a fuzzy subset and calculating the fuzzy distance transform (FDT) of the fuzzy subset.
2. The method of claim 1, wherein the calculating step comprises assigning to a point in the fuzzy subset its respective fuzzy distance from a complement of a support of the fuzzy subset.
3. The method of claim 2, wherein the support comprises a set of all points in the fuzzy subset with a value greater than or equal to a support value.
4. The method of claim 3, wherein the FDT is in digital cubic space.
5. The method of claim 3, further comprising the step of sampling FDT values along the medial axis of the support of the fuzzy subset to estimate regional target object thickness distribution.
6. The method of claim 5, wherein the target object comprises bone marrow space, cortical bone, blood vessels or lung airways.
7. The method of claim 5, wherein FDT is computed in digital cubic space of resolution of target object thickness or smaller.
8. The method of claim 7, wherein the target object is in or from an animal or human subject.
9. The method of claim 8, wherein the image is obtained by magnetic resonance or computed tomography.
10. The method of claim 4 whereby FDT values are sampled along the medial axis directly computed from the fuzzy subset.
11. The method of claim 10, wherein the FDT is in digital cubic space.

12. The method of claim 11, wherein the target object comprises bone marrow space, cortical bone, blood vessels or lung airways.
13. The method of claim 11, wherein FDT is computed in digital cubic space of resolution of target object thickness or smaller.
14. The method of claim 13, wherein the targetted object is in or from an animal or human subject.
15. The method of claim 14, wherein the image is obtained by magnetic resonance or computed tomography.
16. The method of claim 3, further comprising applying one or more additional steps consisting of skeletonizing, feature extracting; analyzing morphological or shape-based object, computing regional object depth; calculating average or regional object thickness distribution; and local scaling.
17. A fuzzy distance transform-based computational method for evaluating or diagnosing bone disease in a subject by analyzing digital images defining at least one volumetric region of bone from or in said subject, said method comprising: (a) obtaining an image of targeted bone region; (b) finding a plurality of points in the image to generate a fuzzy subset and calculating the fuzzy distance transform (FDT) of the fuzzy subset.
18. The method of claim 17, wherein the calculating step comprises assigning to a point in the fuzzy subset its respective fuzzy distance from a complement of a support of the fuzzy subset.
19. The method of claim 18, wherein the support comprises a set of all points in the fuzzy subset with a value greater than or equal to a support value.
20. The method of claim 19, wherein the FDT is in digital cubic space.
21. The method of claim 19, further comprising the step of sampling FDT values along the medial axis of the support of the fuzzy subset to estimate regional target object thickness distribution.

22. The method of claim 17, further comprising selecting a therapy based on the diagnosis or evaluation of bone disease in the subject
23. The method of claim 22, further comprising administering said therapy to said subject.
24. The method of claim 23, wherein said evaluation further comprises monitoring the progression or regression of bone disease in the subject, during or at one or more times after administering said selected therapy.
25. A dynamic programming-based algorithm to compute fuzzy distance transform (FDT) by means of a plurality of points in an image of a target object used to generate a fuzzy subset, and to calculate the FDT of the fuzzy subset, said FDT terminating in a finite number of steps.
26. The algorithm of claim 25, further comprising a means for assigning to a point in the fuzzy subset its respective fuzzy distance from a complement of a support of the fuzzy subset.
27. The algorithm of claim 26, wherein the support comprises a set of all points in the fuzzy subset with a value greater than or equal to a support value.
28. The algorithm of claim 27, wherein the FDT is in digital cubic space.
29. A system for analyzing digital images by a fuzzy distance transform-based computational method comprising:
 - a means for obtaining an image of a target object
 - a means for defining a volumetric region of an object from an image;
 - a means for finding a plurality of points in the image to generate a fuzzy subset;
 - and
 - a means for calculating the fuzzy distance transform (FDT) of the fuzzy subset.
30. A device for analyzing digital images by a fuzzy distance transform-based computational method comprising::
 - a computer-readable signal-bearing medium;
 - means in the medium for acquiring or reading a 3D image of at least one volumetric region of a target object;
 - means in the medium for identifying a plurality of points in the image to generate a fuzzy subset; and

a means in the medium for calculating the fuzzy distance transform (FDT) of the fuzzy subset.